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An Update on Regional Profile Assimilation and Near-Real-Time Modeling Plans

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AIRS Science Team Meeting – September 2006

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transitioning unique NASA data and research technologies to the NWS

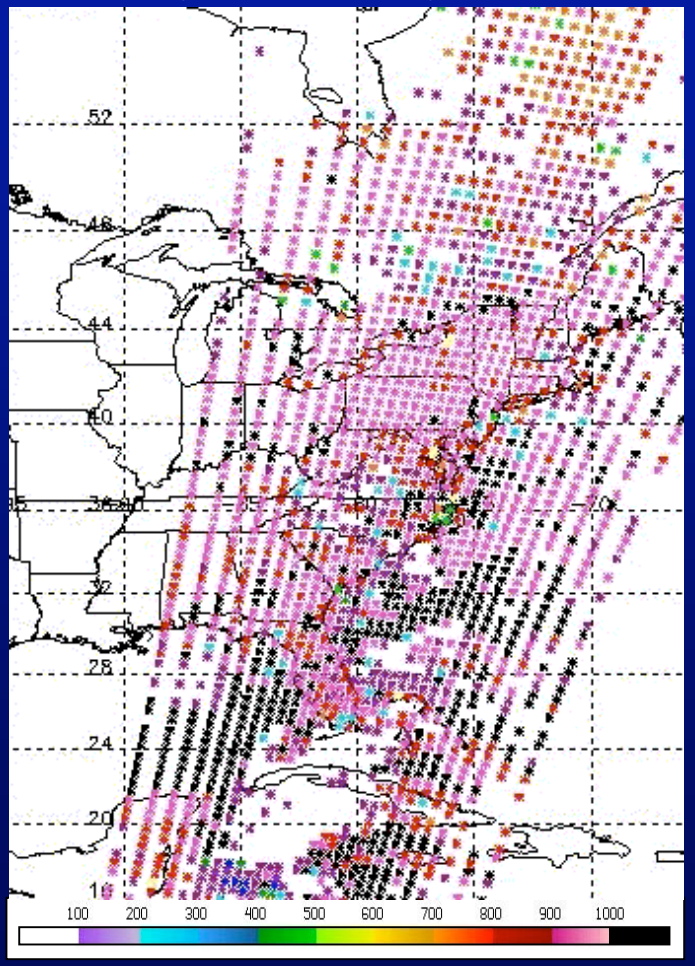
Outline

- Motivation
- Overview of Previous AIRS Science Team Meeting Presentations
- New Results from Assimilation/Forecasting Work
- Near-Real-Time (NRT) AIRS Assimilation
- Brief Discussion

Motivation

- AIRS data complements traditional upper-air observations in data sparse regions (e.g. ocean).
- Hyperspectral nature of AIRS sounder allows for highest vertical resolution of any current remote sensing system
- In-house computing resources at SPoRT are currently not able to handle radiance assimilation
- Level-II profiles provide a straightforward method for obtaining information in data-void regions without running complex RTA
- Profiles are easier to handle than radiances in a NRT environment

Sample swath of AIRS data with prototype V5.0 quality indicators



Summary of Recent Results

- ADAS configured to optimally assimilate AIRS thermodynamic profiles intelligently using quality indicators (QIs) to determine largest volume of highest quality data
- Short WRF forecast used as background for ADAS analysis (previously initialized with GFS, but discussing moving to the NAM), WRF produced 65-h forecasts
- Two case studies: west coast (V4.0, Jan. 2004) and east coast (prototype V5.0, Nov. 2005)
- Impact in temperature and moisture analyses in region of AIRS data
- Overall positive impact on temperature and moisture forecasts with the inclusion of AIRS profiles
- Prototype V5.0 data reduced bias and RMSE of temperature and moisture in forecasts when compared to RAOBs—improvements in RTA and QC

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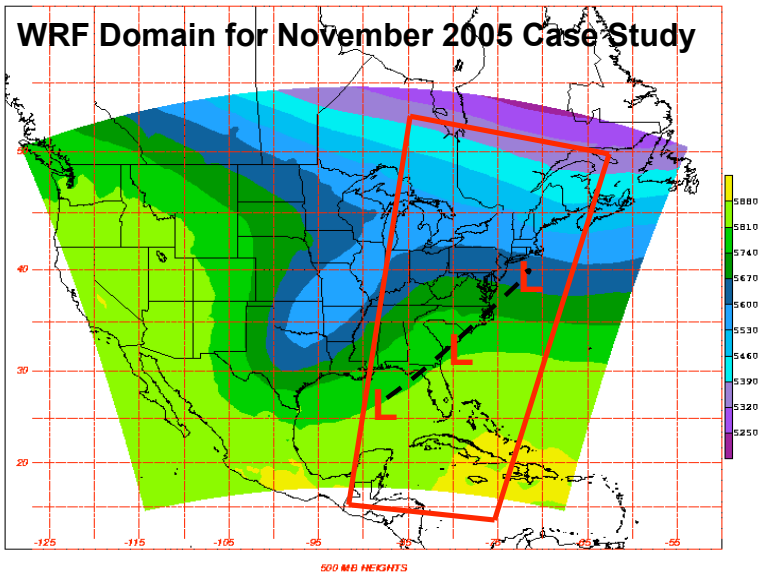
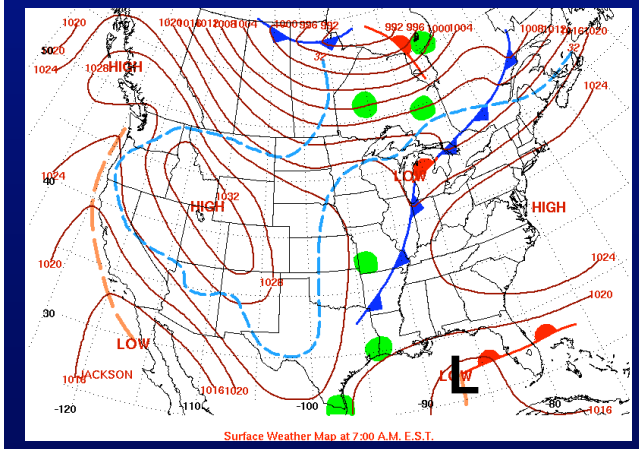
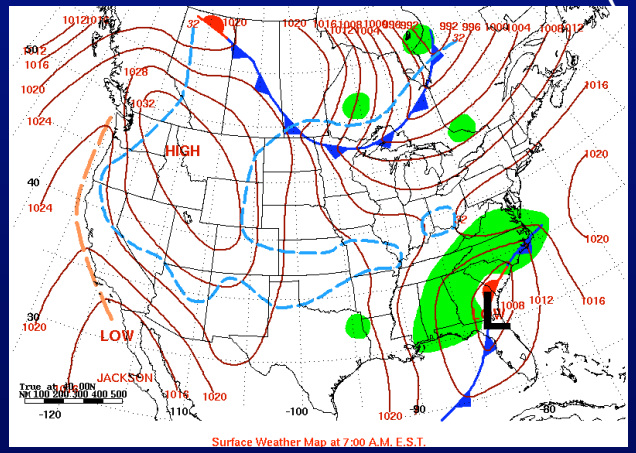
Case Study: November 20-22, 2005



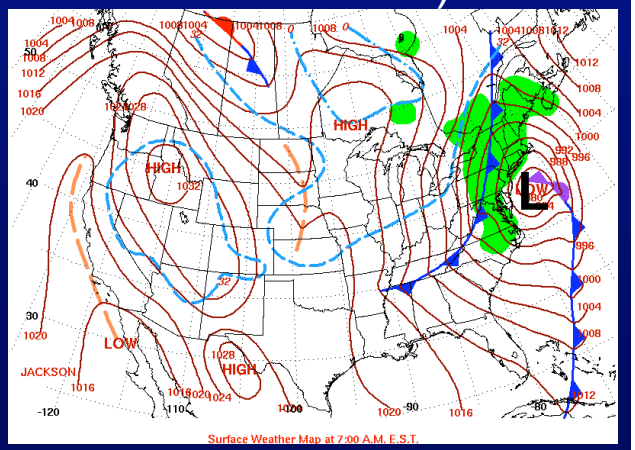
- WRF domain covers most of CONUS—similar domain to be used for testing NRT
- Rapidly intensifying storm in region relevant to SPoRT interests
- Under forecasted by operational models at storm's strongest point—potential impact
- Ample verification data available over the Eastern US (minimal terrain issues)



Surface analysis 11/20/05 12 UTC



Surface analysis 11/21/05 12 UTC



Surface analysis 11/22/05 12 UTC

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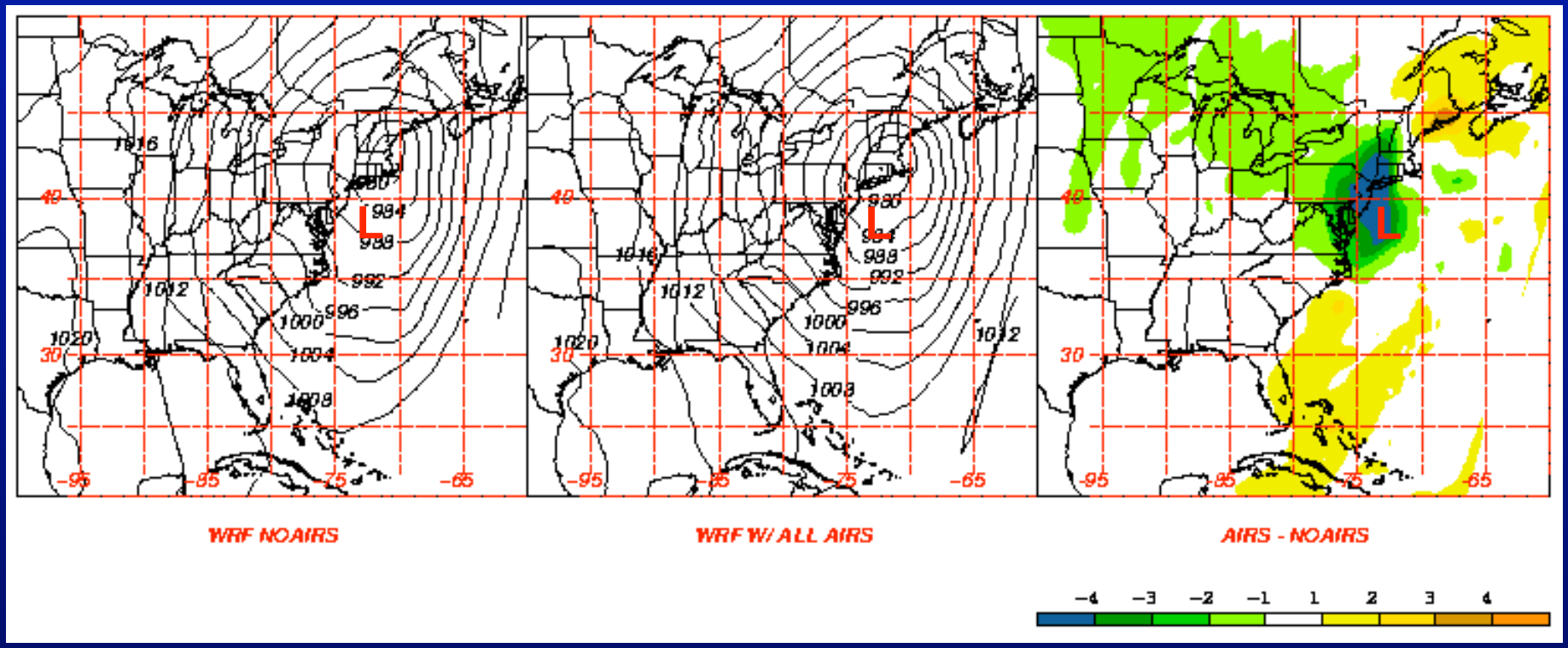
53h Forecast Impact—Mean Sea Level Pressure

Valid at 1200 UTC 22 November 2005



- Low pressure area deepens by more than 4 hPa with inclusion of AIRS data
- Storm center shifts slightly to the south and west
- Both alterations are improvements over the control when compared to surface analysis

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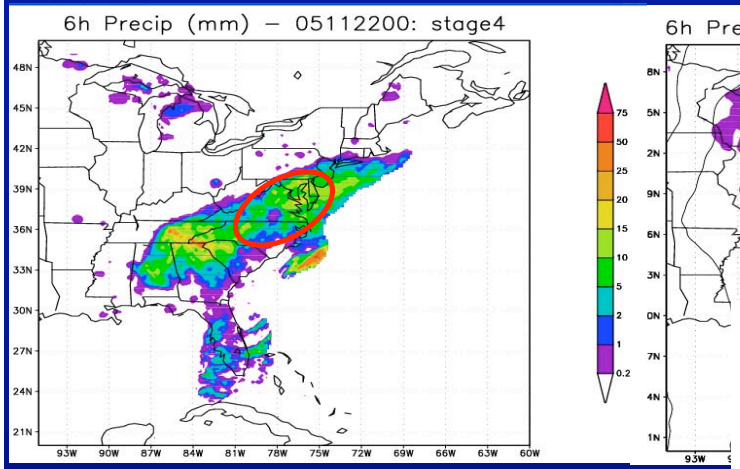
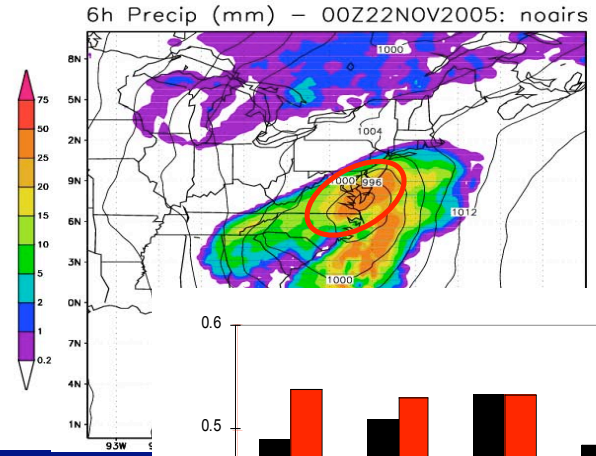
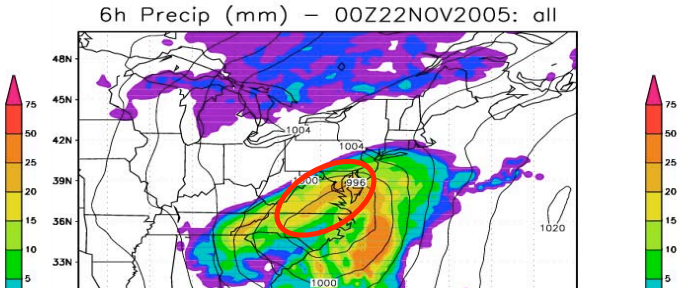
41h Forecast Impact—6h Cumulative Precipitation

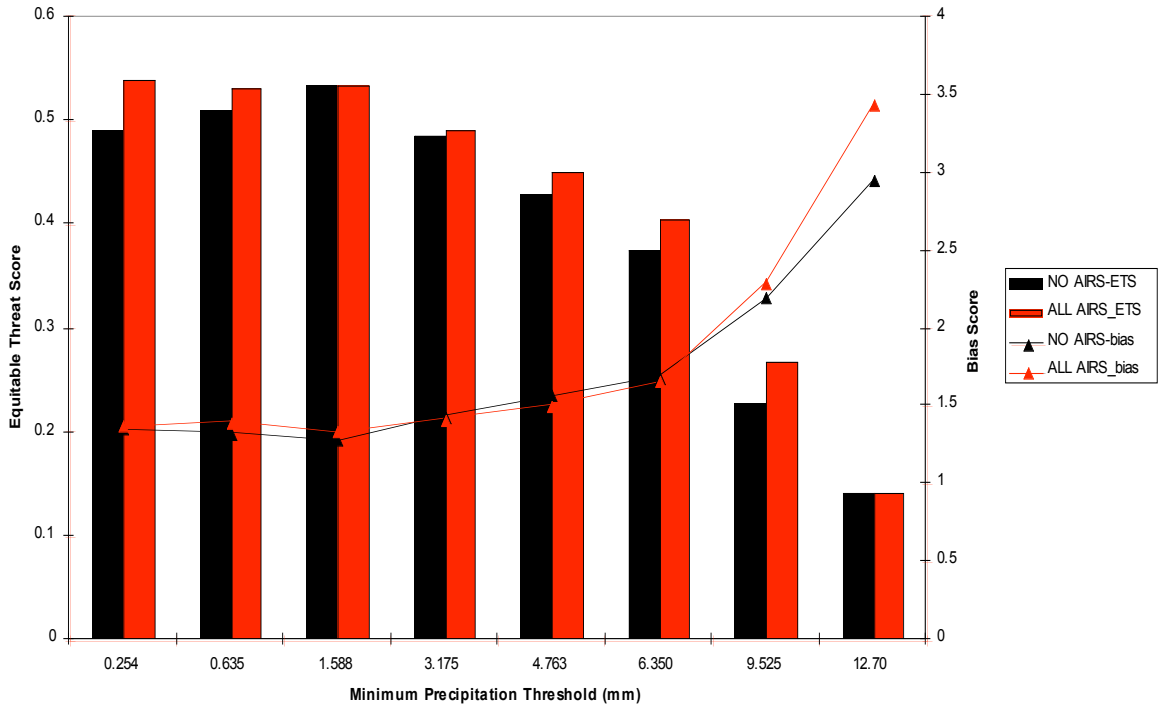
Valid at 0000 UTC 22 November 2005







- Subtle precipitation coverage difference between control & AIRS
- AIRS seems to better forecast intensity (MD/DE/VA)
- ETS for AIRS case similar to or better than the control
- AIRS case bias score comparable to control



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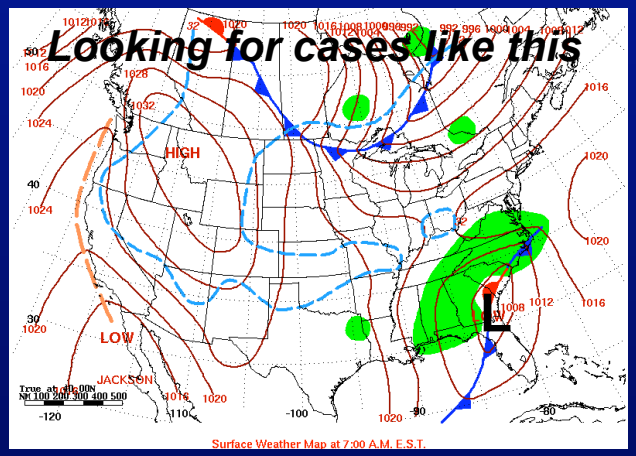
NRT Assimilation

- Single case studies are not necessarily representative (statistically significant) of overall model performance

- Twice daily model runs (AM and PM) for a contiguous period

- Initial sensitivity study using *over water* soundings (latest prototype V5.0) will help determine optimal data set for later NRT assimilation:

  - **CNTL: control; use no AIRS data**
  - **NOQC: use all AIRS data without regard for QIs**
  - **BEST: use only full soundings**
  - **ALLW: use QIs to select the highest quality data**

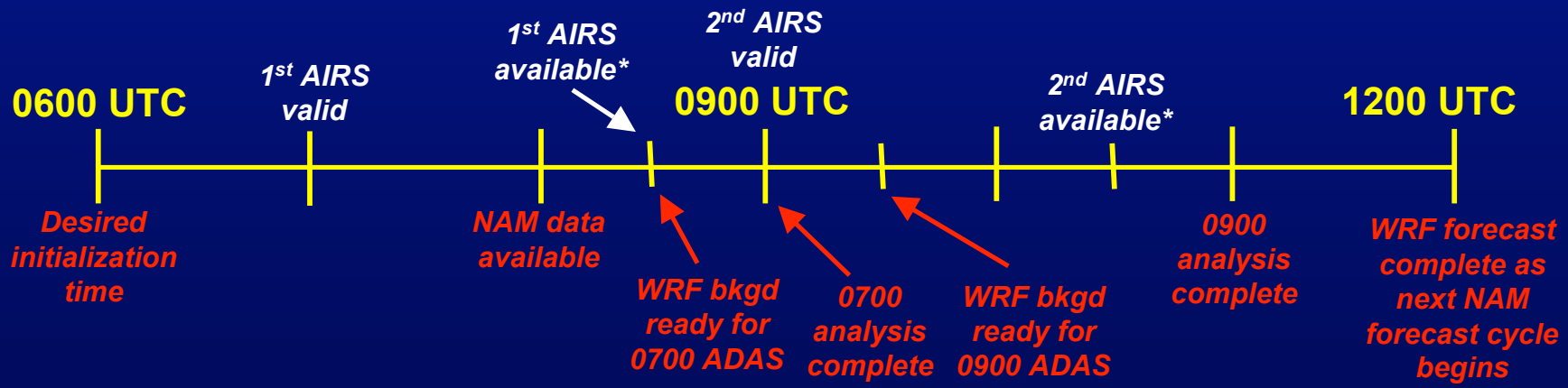


- Troubleshoot process, determine case studies, and provide results for a journal article

- Date, time, and location of AIRS data will control which data are used and will run system from pre- through postprocessing

NRT Assimilation

- NAM is run 4 times daily with a lag time of ≈ 2 hours; ≈ 3 hours for 0-48 hour forecasts
- 1-hr WRF forecasts can be completed in 30 seconds; 48-hr forecast can be completed in under 9 minutes using full capabilities of our cluster
- Preprocessing of AIRS profiles into ADAS format takes ≈ 5 minutes
- Assimilation of AIRS profiles in current configuration takes ≈ 10 minutes
- Time lag of AIRS data processing—how long after observation time until data are available? Ideally, we would like AIRS data to be available ≤ 2 hours after valid time*



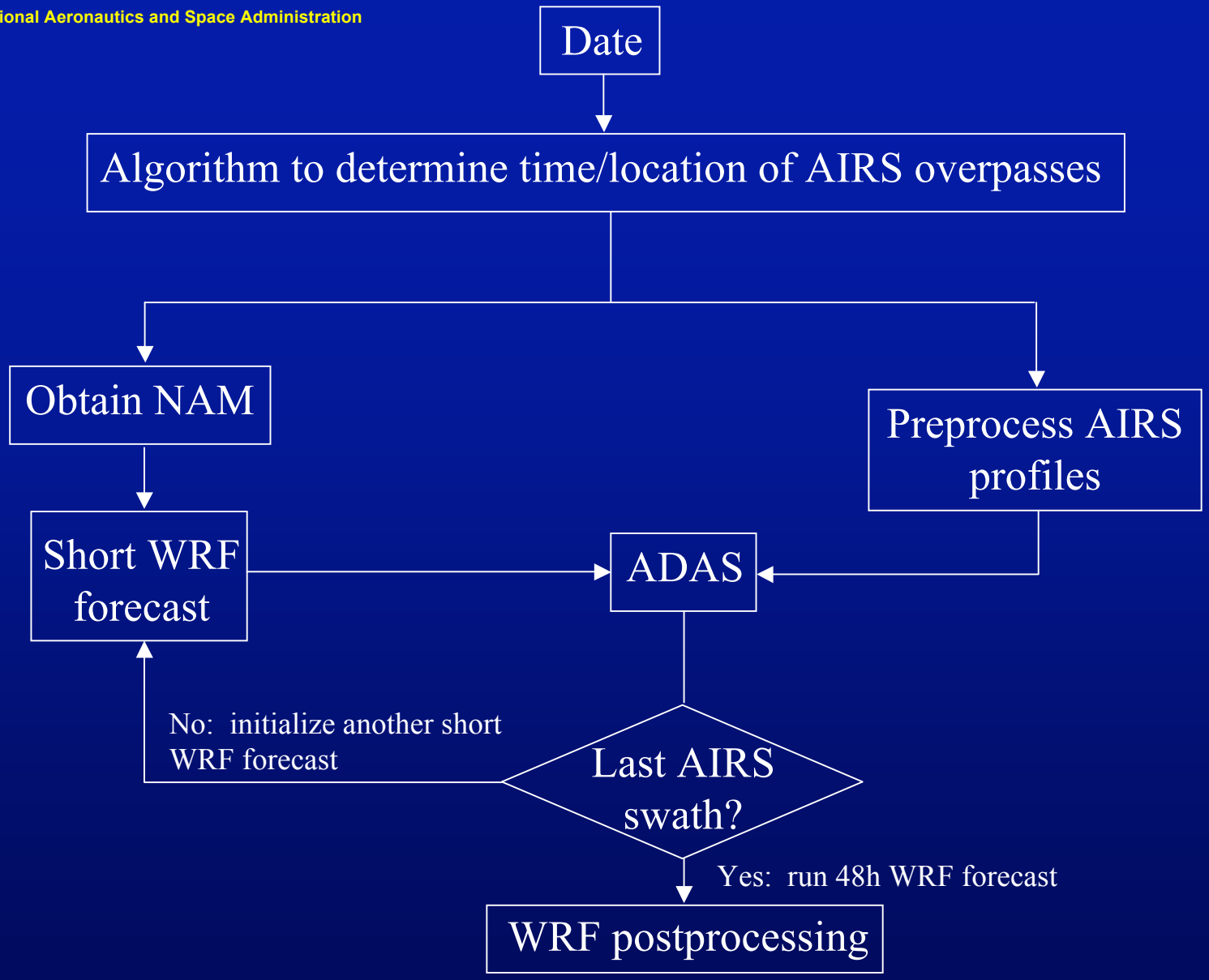
Verification of Forecast Impact

- Verification at 6-hour intervals at each grid point using analyses (F00) collocated in time to calculate bias and RMSE for:
  - **temperature, specific humidity, height, MSLP, winds**
- Verification at 3-hour intervals in each grid box using extrapolated NCEP Stage IV precipitation data to calculate equitable threat scores and bias scores for:
  - **6h and 24h cumulative precipitation totals**
- Time series of MSLP for the forecast period for each case against METAR data along the east coast
- If month-long set of cases yields extra-tropical cyclone events, storm tracks between the various model runs and observations can be compared
- Results will be posted daily on the SPoRT website after forecast run to track the statistics

Conclusions/Wrap-Up

- Improvements in temperature, moisture, MSLP, and precipitation fields at various forecast times with addition of AIRS profiles for one case study
- More thorough assessment through extended NRT study
- AIRS Level-II thermodynamic profiles are desired in NRT with less than 2 hours lag for continued research
- We would like to test our system with at least a month of NRT prototype V5 data prior to the official V5 release

Supplemental Slides


Date
Algorithm to determine time/location of AIRS overpasses
Obtain NAM
Preprocess AIRS profiles
Short WRF forecast
ADAS
No: initialize another short WRF forecast
Last AIRS swath?
Yes: run 48h WRF forecast
WRF postprocessing